A SURVEY OF THE MISTLETOE OF NEW SOUTH WALES.

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(Plate vi; nineteen Text-figures.)

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Introduction.

In recent years considerable interest has been aroused by the apparently increasing incidence of Mistletoe (species of the Loranthaceae) on trees in New South Wales. Where infestation is heavy there is little doubt that the economic effects are serious. Fruit and timber trees as well as ornamental and shelter trees are all liable to attack by the members of this group of hemi-parasites.

The germination of the seed, development of the young plant on the host and penetration of its haustoria have been discussed by McLuckie (1923) and need not be considered here. When the parasite has become established on a branch of the host it apparently cuts off supplies of water and mineral salts from the parts of the branch beyond the point of infection. Loss of foliage occurs and often this part of the branch is so injured that it dies and is shed, the Mistletoe thus assuming a terminal position. Because of this the host plant may develop a straggling habit, lack of symmetry caused by the parasite sometimes being extreme. The quality of the timber may be affected adversely by the swellings at the junction of host and parasite; this is of greatest significance when the infection is on the bole itself. Several reports have been received of secondary infection by fungal and insect pests through the gap in the host tissue left by the death of a Mistletoe. Even where the trees are of too poor a quality to be of economic importance as timber, their destruction by the parasite may leave the way open to increased soil erosion and consequent depreciation of land values. Parasitized plants have also been reported to have a lower production of flowers, pollen, honey and fruit. It has also been reported that if trees with and without Mistletoe are felled, the healthy ones give rise to numerous suckers, but the infected trees do so very rarely.

Field observations indicate that the presence of Mistletoe leads to a reduction in the rate of growth of the host tree. As a result of this it assumes a ragged appearance, and, if the tree is not treated, it will finally die. The term "finally" is used advisedly; most observers quote about twenty years as the time needed for Australian Mistletoes to kill a host, although others quote as short a time as six months. The time varies according to the species of host and parasite, age of host, the conditions of growth and the number of infections present.

No experiments in Australia have been recorded which give actual measurements of the reduction in growth rate of the host, but it is of interest to note the observations of workers in other countries where Mistletoe is a pest. Boyce (1925) says: "In eastern Oregon . . . it was found that the height of infected 100-year-old yellow pines was 36% less than normal individuals of the same age, while diameter growth was reduced 17%. These figures for Douglas firs of the same age were 15% and 20%, while for the western larch they were 45% and 41%." Nuessle (1930), from Germany, reports observations on five similarly situated branches of a medium-sized red fir tree.

* This paper was prepared when the writer held a Linnean Macleay Fellowship in Botany.

One of the branches, which carried a heavy growth of Mistletoe, became devitalized upon reaching a length of only 80 cm., and was bare of needles, while the healthy branches measured 150 cm. Haan (1928), from the Dutch East Indies, reported a 20–30% loss of harvest in kapok plantations, due to Mistletoe infection.

In view of the economic importance of Mistletoe in New South Wales, therefore, it appeared desirable to attempt to survey the species occurring in this State, studying their distribution, abundance and incidence on various species of host, and to co-ordinate existing information on control measures and on conditions affecting their dispersal.

Methods of Investigation.

The data discussed below have been obtained from field observations by the writer, from records in the National Herbarium, from the monograph on the Loranthaceae of Australia by Blakely (1922–28), and from reports received from observers over a wide area in New South Wales. In order to obtain detailed information as to the present distribution of, and damage caused by, various species of Mistletoe, questionnaires were distributed to agricultural workers, foresters and others interested, and over three hundred replies were received, many answers being accompanied by further information in letter form. Specimens of Mistletoe and host were forwarded in many cases, thus enabling specific determinations to be made. It is recognized that the method of collecting information by means of questionnaires is subject to certain limitations, owing to variability in the methods of observation of those responding. Nevertheless it is felt that an analysis of a large number of replies does yield a considerable amount of valuable information.

Distribution of Mistletoe.

Blakely (1922–28) has recorded that Mistletoe occurs all over Australia, except in Tasmania. It occurs in varying amounts throughout New South Wales, and in the present survey an attempt has been made to determine its relative abundance in different districts. In Plate vi the total amount of all species for each locality is indicated.

From the answers to the questionnaires received, each locality was classified as belonging to one of the arbitrary groups of 0–1, 1–5, 5–20, 20–50 or over 50% infection, computed on the number of trees infected per hundred, irrespective of the number of infections per tree; Plate vi shows the result obtained from this analysis. The size of the dots is directly proportional to the heaviness of infection in each area. Mistletoe tends to occur in local patches; therefore the density shown in the plate can indicate only an estimate for each district. Any interpretation of this map must therefore be made with caution. Examining the same data by means of histograms (Fig. 19), it appears that there is a lighter infection to the south than the north, and less to the west than the central (Tablelands) or coastal portions of the State. In the central districts there is less very light or very heavy infection than on the coast, i.e., infection in the coastal districts is more sporadic.

From all over the State come reports of an increase in the amount of Mistletoe during the last two or three decades. Some observers suggest that this is due to drought conditions making the effects of infection more noticeable, but others claim that an actual increase has occurred during the last 40 years in their districts.

Twenty-nine species of Mistletoe occur in New South Wales; these are comprised of twenty species of *Loranthus*, four of *Phrygilanthus*, three of *Notothixos*, one of *Korthalsella* and one of *Viscum* (Table 1). Maps have been constructed showing their distribution in this State (Figs. 1 to 14); these are summarized in Table 1. In constructing these maps the shire, or county in the Western Division, has been used as a unit. Against the name of each species quoted (Table 1) is noted whether this plant occurs here on many hosts or is limited to one or a few. In the latter case the distribution of the host plant may, obviously, determine the range of the parasite.

Some trees may be immune in certain localities, but where Mistletoe is very prevalent in their vicinity, they will be found to be attacked. There have been many claims by local observers that certain tree species are resistant to infection in their

TABLE 1.

Distribution of Different Species of Mistletoe in New South Wales.

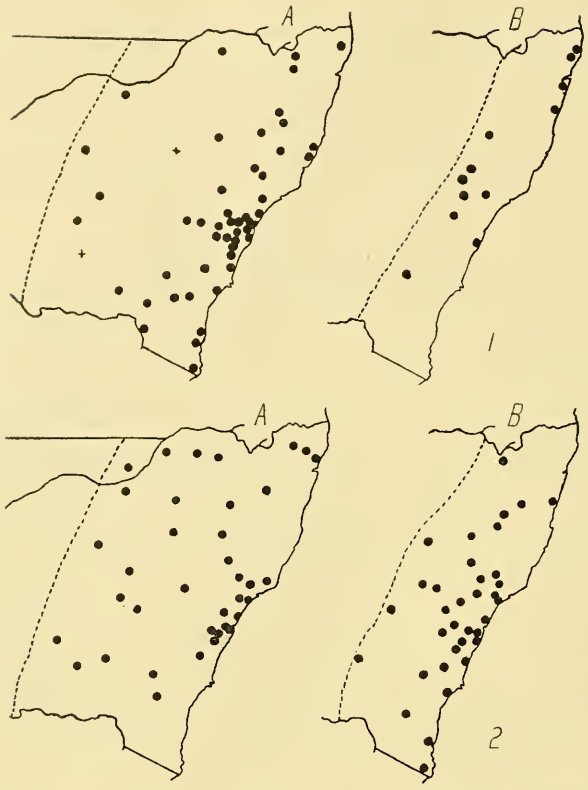
Species.	Districts.												Fig.	Remarks.
	Northern.				Central.				Southern.					
	Coast.	Tablelands.	Plains.	Far West.	Coast.	Tablelands.	Plains.	Far West.	Coast.	Tablelands.	Plains.	Far West.		
Phrygilanthus celastroides (Sieb.) Eichl.	x				x				x				7*b*	Many hosts.
Notothixos incanus Oliv.	x	x			x	x			x	x			—	,, ,,
N. cornifolius Oliv.	x	x			x	x			x	x			1*b*	On *Brachychiton populneum*.
P. eucalyptoides (DC.) Danser	x	x			x	x			x	x			2*b*	Many hosts.
Loranthus vitellinus Muell.	x	x	x		x	x			x	x	x		10*b*	,, ,,
L. Cambagei Blakely	x	x	x		x	x	x		x	x	x		2*a*	Usually on *Casuarina* sp.
L. pendulus Sieb.	x	x	x		x	x	x		x	x	x		1*a*	Many hosts.
L. Miquelii Lehm.	x	x	x	x	x	x	x	x	x	x	x	x	14	,, ,,
L. Murrayi Muell. *et* Tate				x				x				x	4*a*	Usually on *Acacia* sp.
L. Preissii Miq.			x	x			x	x			x	x	3*a*	,, ,, ,, ,,
L. Lucasi Blakely			x	x			x	x			x	x	8*a*	Many hosts.
L. Quandang Lindl.		x	x	x		x	x	x			x	x	7*a*	,, ,,
L. linophyllus Fenzl.	x	x	x	x	x	x	x	x			x	x	13	Usually on *Casuarina* sp.
L. miraculosus Miq.			x	x	x	x	x	x	x	x	x	x	5*a*	Many hosts.
L. Maideni Blakely			x	x			x	x					6*a*	Usually on *Acacia* sp.
L. grandibracteus Muell.			x	x			x						9*a*	Many hosts.
L. Exocarpi Behr.		x	x	x	x	x	x	x			x	x	12	,, ,,
Korthalsella articulata (Benth.) Blakely	x	x	x		x	x	x		x				4*b*	,, ,,
L. congener Sieb.	x	x			x	x			x				3*b*	,, ,,
L. ferruginiflorus Fitz.	x	x	x										9*b*	On *Eucalyptus* and *Angophora* spp.
N. subaureus Oliv.	x	x			x	x							6*b*	Usually on other Mistletoes.
L. gaudichaudi DC.	x	x			x								—	Usually on *Melaleuca* sp.
Viscum angulatum Heyne	x				x								—	Many hosts.
L. dictyophlebus Muell.	x	x			x								8*b*	,, ,,
L. alyxifolius	x	x			x								5*b*	,, ,,
L. Betchei Blakely	x												—	,, ,,
L. Mitchellianus (Hook.) Blakely			x				x						10*a*	,, ,,
P. Bidwillii (Benth.) Eichl.		x	x			x	x			x	x		11	Usually on *Callitris* sp.
P. myrtifolius (Cunn.) Eichl.		x											—	One record only.

districts, but in all such cases (provided there have been several reports concerning the same species) reports of infection come from other districts.

Fruit trees furnish an example of plants liable to infection wherever they occur. In New South Wales these are grown on the coastal plains, to a less extent on the Tablelands, and least in the west: the amount of damage suffered follows the same order as the density of cultivation. The Mistletoe species causing most trouble to fruit trees are *Phrygilanthus eucalyptoides*, *Loranthus vitellinus* (including var. *glabrescens*) and *L. congener*. Others that occur are *Korthalsella articulata*, *Loranthus alyxifolius*, *L. Exocarpi*, *L. Cambagei* and *Phrygilanthus celastroides*.

One of the trees which may be attacked in any district where it occurs is Wilga, *Geijera parviflora* Lindl. (Fig. 15). The species attacking this plant are *Korthalsella articulata*, *Loranthus miraculosus* (including var. *Boormani*) and *L. Exocarpi* (including var. *tenuis*), the first two of which are reported to cause severe damage.

The only trees which appear to be free from Mistletoe attack over comparatively wide areas are *Callitris* species and Kurrajong (*Brachychiton populneum* R.Br.). The two most common western tree species of *Callitris*, *C. glauca* R.Br. and *C. calcarata* R.Br.,



Figs. 1-2.—Distribution of certain Mistletoes in New South Wales. Solid circles indicate that the species has been identified from the district (shire, or county in the Western Division) indicated. Hollow circles indicate additional districts where the variety named has been obtained. Crosses indicate that the species has been reported (only) from the district shown.
1.—A. *Loranthus pendulus* Sieb. B. *Notothixos cornifolius* Oliv. 2.—A. *Loranthus Cambagei* Blakely. B. *Phrygilanthus eucalyptoides* (DC.) Danser.

are attacked by the one Mistletoe, *Phrygilanthus Bidwillii*, which is almost confined to species of *Callitris*, and occurs on them both over the same areas (Fig. 16). The zone of heaviest infection is in the Northern Tablelands. Around this there is a zone of lighter infection extending south and westwards. With one slight exception (reported in the Shire of Coreen), *Callitris* growing in the south-central and south-western areas has not been found attacked, even though Mistletoes are present and occur on associated plants. Despite the numerous reports of the absence of Mistletoe infection on *Callitris* in these districts it must be remembered that Mistletoe is less prevalent here on any host, and *Phrygilanthus Bidwillii* has not yet been reported in this district. The map showing the distribution of *P. Bidwillii* (Fig. 11) almost coincides with that showing the infection of these species of *Callitris* (Fig. 16).

As in the case of *Callitris*, the areas where infection on Kurrajong has not been recorded are those where all Mistletoes are relatively rare (Fig. 17). The most important Mistletoe infecting this valuable fodder tree is *Loranthus vitellinus* (including var. *glabrescens*); others are *Notothixos cornifolius*, *N. subaureus* and *Phrygilanthus eucalyptoides*. Infection of Kurrajong by Mistletoe is reported as being extremely serious and rapidly causing much damage.

As species of *Eucalyptus* and *Acacia* are the most abundant elements in the Australian flora, they are the most usual hosts. Other frequent hosts and their infecting Mistletoes are listed in Table 2.

TABLE 2.

Common Hosts and their Infecting Mistletoes.

Host.	Mistletoe.
Cytisus species	*Loranthus pendulus*, *L. vitellinus* (incl. var. *glabrescens*), *Phrygilanthus eucalyptoides*.
Eremophila species	*Korthalsella articulata*, *L. Cambagei*, *L. Exocarpi*, *L. linophyllus*, *L. miraculosus* (incl. var. *Boormani*), *L. Mitchellianus*, *L. Quandang*, *L. vitellinus* var. *glabrescens*.
Flindersia maculosa F. v. M.	*L. miraculosus* var. *Boormani* (N.S.W. ?), *L. Mitchellianus* (N.S.W. ?), *L. Quandang*, *L. Lucasi*.
Heterodendron oleaefolium Desf.	*L. Exocarpi* (incl. vars. *flavescens*, *tenuis* and *vennulosa*).
Pittosporum phillyraeoides DC.	*L. Exocarpi* (incl. var. *tenuis*), *L. miraculosus*.
Santalum and *Fusanus* species..	*K. articulata*, *L. Exocarpi* (incl. var. *vennulosa*), *L. Quandang*, *L. miraculosus* (incl. var. *Boormani*).

Conditions Affecting the Local Distribution of Mistletoe in New South Wales.

Although all species of *Eucalyptus* seem liable to infection, reports suggest that in most districts a greater percentage of smooth-barked trees appears to be affected. Plants may become infected at practically any age.

Numerous replies received indicate that Mistletoe is more prevalent where the soil is poor. Mr. E. C. Powell of Parkes has given an estimate (Table 3) of the percentage occurrence of host trees and their percentage infection by Mistletoe on different soils in a locality about twelve miles from Tomingley on the Dubbo–Peak Hill Road. He

TABLE 3.

Estimate of Percentage Occurrence of Host Trees and Mistletoe Infection on different Soils near Tomingley (Dubbo-Peak Hill Road).

——	Iron-bark %	Gum %	Stringy-bark %	White Box %	Yellow Box %	Pine %
On granite ridges (grey)..	40	45	10	—	—	5
Mistletoe infection	20	40	10	—	—	0
On granite soil	35	25	—	15	—	25
Mistletoe infection	5	15	—	5	—	0
Better soil (mainly granite)	15	20	—	35	10	20
Mistletoe infection	5	5	—	0	1	0
Granite ridges (red)	40	50	—	5	—	5
Mistletoe infection	20	35	—	0	—	0

states that the Ironbarks and Gums of the ridges are stunted, lack vigour and are mainly hollow or "piped" (probably 75%). Timber of the granite soil is somewhat better than that on the actual ridges, but is still of poor quality. On the better soil, which, however, is still of a relatively poor type, the trees are healthy and stronger. In this area, it appears that the incidence of Mistletoe decreases as the vigour of the trees improves on the better soils. This result is in agreement with many reports that trees which for some reason are growing less vigorously than the normal tend to become infected.

Reports indicate that, on the western slopes, Mistletoe seems to be more abundant on hills, but that this condition is variable in the mountain and coastal districts; Mistletoe

Figs. 3-8.—Distribution of certain Mistletoes in New South Wales. (For explanatory details see Figs. 1-2.)

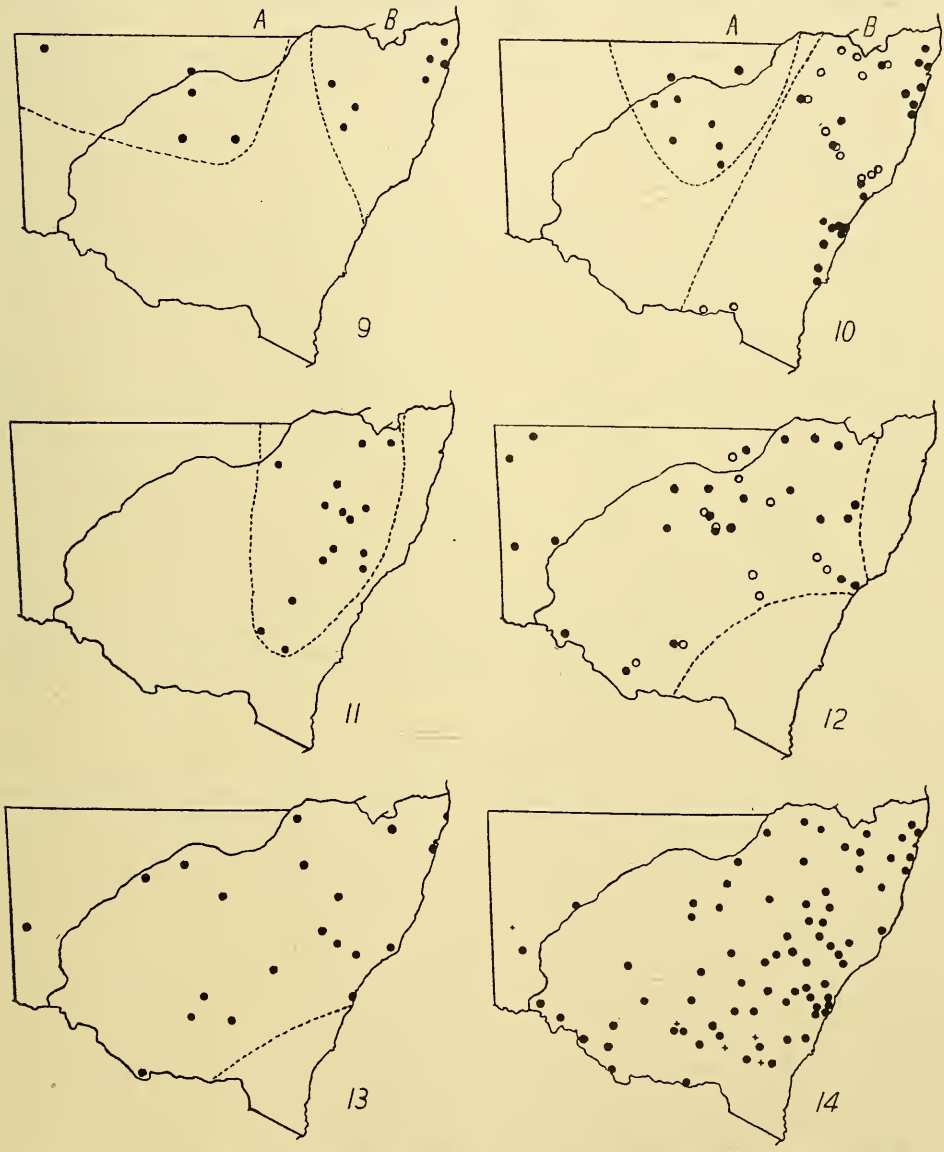
3.—A. *Loranthus Preissii* Miq. B. *L. congener* Sieb. 4.—A. *L. Murrayi* Muell. et Tate. B. *Korthalsella articulata* (Benth.) Blakely. 5.—A. *Loranthus miraculosus* Miq. and var. *Boormani* Blakely. B. *L. alyxifolius* Muell. 6.—A. *L. Maideni* Blakely. B. *Notothixos subaureus* Oliv. 7.—A. *L. Quandang* Lindl. and var. *Bancrofti* Bail. B. *Phrygilanthus eclastroides* (Sieb.) Eichl. 8.—A. *L. Lucasi* Blakely. B. *L. dictyophlebus* Muell.

is absent from high altitudes on the Southern Alps. Some observers say that less Mistletoe occurs on hillsides facing south.

The occurrence of fires may also have an effect on the incidence of Mistletoe. On uncleared land a fire tends to kill the Mistletoes while Eucalypts on which they grow are able to regenerate. On land which has been cleared of undergrowth or which is more or less protected by man, bushfires either do not occur, or, on the rare occasions when they do, are very severe and destroy all timber. Thus the activities of

man result in fire not freeing the host plants of their parasites. This point is worthy of notice, and is perhaps connected with the recent increase in the amounts of Mistletoe.

Where a forest has been partially cleared, the remaining trees tend to be infected much more frequently (this statement however does not seem to apply to the Riverina in the south of New South Wales). For example, Mr. W. A. Crawford (Alstonville) reports that a virgin scrub of two hundred trees bore only one Mistletoe plant, while on a neighbouring area of similar vegetation, but consisting of thinned-out trees and secondary growths, sixteen out of seventy trees had been attacked by Mistletoe. These figures



Figs. 9-14.—Distribution of certain Mistletoes in New South Wales. (For explanatory details see Figs. 1-2.)

9.—A. *L. grandibracteus* Muell. B. *L. ferruginiflorus* Fitz. 10.—A. *L. Mitchellianus* (Hook.) Blakely. B. *L. vitellinus* Muell. and var. *glabrescens* Blakely. 11.—*Phrygilanthus Bidwillii* (Benth.) Eichl. 12.—*Loranthus Exocarpi* Behr. and var. *flavescens* (Muell.) Miq. 13.—*L. linophyllus* Fenzl. 14.—*L. Miquelii* Lehm.

support the statement that trees on semi-cleared land are more liable to infection. It has been noticed also that Mistletoe occurs more on the edge of a forest, in clearings, or near a road, or when in a forest it occurs mostly on boughs projecting above the general level. This preference of Mistletoe for trees or boughs which are not closely surrounded by other trees has been observed also in India and the United States. It is usually attributed to high light requirements of Mistletoe, but may be due to the behaviour of birds which distribute the seeds.

Experiments conducted by the writer on the germination of *Loranthus Miquelii* have shown that embryos placed in the light give a 91% germination, while those kept in darkness give 44%. In the field, of course, such extreme conditions would not exist, since no host would be in absolute darkness.

Reports from all over the State agree that Mistletoe is more abundant near water and in sheltered places. This relationship may be direct as affecting the water needs of host and parasite, or indirect through animal (including bird) behaviour and seed dissemination.

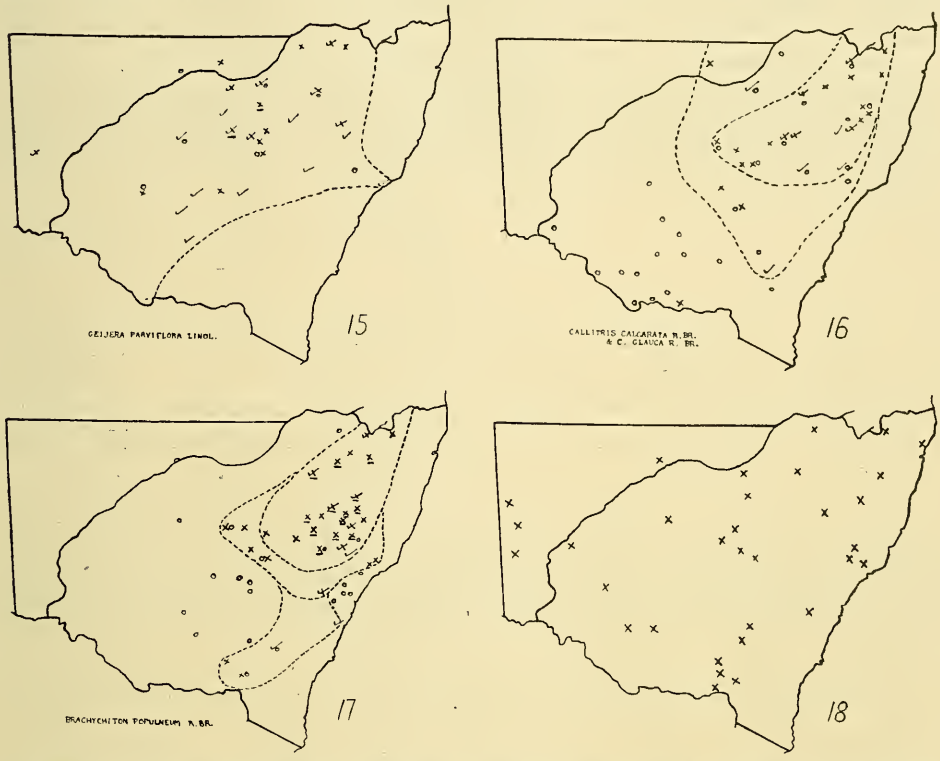
The Mistletoe has a succulent, edible fruit, inside which is the embryo enveloped in mucilage. Experiments indicate that at least in the case of *L. Miquelii*, germination occurs only if the fruit coat has been removed. The young embryos develop readily on inanimate objects or on a potential host plant; often one Mistletoe grows parasitically on another. The writer has found that, in the case of *L. Miquelii*, germination occurs readily even when no additional water is supplied to the embryos. When the "fruit" is eaten by animals, the mucilage-enclosed seed is often either not eaten or it passes through the body unharmed, and so is able to germinate wherever discarded or excreted by the animal. Many birds distribute the Mistletoe seed. In France (Anon., 1934) *Viscum* is reported to be more prevalent along the routes taken by migratory birds. Numerous birds of New South Wales have been reported as eating the fruits and distributing the seeds of Mistletoe. The Mistletoe bird, *Dicaeum hirundinaceum* (Shaw), has been recorded from the far west as well as the coastal and mountain regions, and is regarded by many as the chief distributing agent in this State. Hâan (1928) reports another species of *Dicaeum*, *D. flammeum*, as spreading *Loranthus* in kapok plantations in the Dutch East Indies. In New South Wales *Dicaeum* is only one of many birds which distribute the seeds. The King Parrot, *Alisterus scapularis* (Lichtenstein), is reported to chew the fruit, thus destroying the embryo and controlling, not spreading, the Mistletoe. Sugar squirrels and flying-foxes are also reported to distribute Mistletoe. It has been reported that the faeces of the flying-fox contain immense numbers of Mistletoe embryos.

Many claims have been made that the present increase in the amount of Mistletoe is due to a decrease in the number of opossums and/or koalas. The evidence on this point is inconclusive. The Shire Council at Bland (Black, 1928) reports Mistletoe as increasing where koalas have never been known to exist. Mr. N. Burnet, of Koala Park near Sydney, stated (*Sydney Morning Herald*, Nov. 7th, 1935): "At Koala Park, where bears are afforded as much liberty as possible, and where Mistletoe is prevalent, not a single instance of bears or opossums eating such leaves has been observed." (The Mistletoe growing at Koala Park is *Phrygilanthus eucalyptoides*.)

Experimental work in Queensland, by Young (1937), indicated that opossums show a general preference for Mistletoe (*Loranthus vitellinus* and *L. pendulus*), whilst koalas sometimes eat one species (*L. pendulus*), if grown on *Eucalyptus*. It seems that koalas and opossums do eat certain species of Mistletoe, perhaps only as a change of diet, but their significance in the control of Mistletoe in New South Wales is not yet clear. Two-thirds of the reports received concerning opossums claim that they control the spread of Mistletoe, the other third stating that they distribute the seeds of this parasite.

During droughts, Mistletoe is frequently lopped for fodder, so there is less chance of the amount becoming excessive in districts where droughts are common and grazing continuous. From many parts of New South Wales come reports of sheep, cattle or camels eating it when available (Fig. 18); from Hay there is a report that cattle eat

Mistletoe even when they are on green pasture. The species which are eaten include *Loranthus Exocarpi, L. linophyllus, L. Maideni, L. miraculosus* (including var. *Boormani*) and *L. Mitchellianus.*



Figs. 15-17.—Maps showing the districts in which certain hosts are infected by Mistletoe. Crosses indicate that infected material has been identified, ticks that reports of infection have been received, and underlining that these reports are accompanied by claims of severe damage caused. Circles indicate that the host is here reported as never attacked by Mistletoe.

Fig. 18.—Map showing those districts of New South Wales where stock are reported as eating Mistletoe when available.

Control of Mistletoe.

Frequently dead Mistletoe may be seen on living hosts; often such hosts are surrounded by trees bearing living Mistletoe. Mr. F. J. Bendeicht (Belford, via Singleton) describes one area where 80% of the Mistletoe occurring on the Spotted Gum is dead. The reason for this behaviour is not known. It has been suggested by an observer at Wollondilly that scale insects have killed the Mistletoe; but near Sydney scale insects are prevalent without exercising any apparent control over Mistletoe. From Bogan and Woodburn it is reported that wood-boring beetles kill the Mistletoe, but these reports come from districts where Mistletoe is still common. Leaves of *Loranthus Miquelii* which were dying (collected by the writer near Kurrajong) were investigated for the presence of bacteria, but no strains which reinfected the leaves were found. Larvae were found by the writer in fruits of *L. Miquelii*, the plant embryo being completely replaced. These larvae were bred through and the flies identified by Mr. F. A. Perkins (Queensland University) as *Paratrirhithrum loranthi* (Froggatt). The flies of this group are orchard pests, so are not suitable for use as a practical means of control of Mistletoe. Apparently no effective method of biological control has been discovered as yet in any part of the world. Probably *Loranthus vitellinus, Phrygilanthus eucalyptoides* and *L. Miquelii* are the species of Mistletoe whose control in New South Wales is most desirable owing to the damage they cause.

The work of Brooks and Bailey (1919) appears to indicate that a parasitic fungus inside the tree (*Stereum purpureum*) may be killed by the injection of appropriate poisons, without injury to the tree. This suggested the possibility that a substance having a similar action with regard to Mistletoe might be found. The Commonwealth Council for Scientific and Industrial Research initiated experiments along these lines; in most cases, however, host and parasite both died, although the Mistletoe died far more quickly than did the host. It seems the slight difference in tolerance to a toxic substance by host and parasite would not make this method practicable. Further, the effect is not permanent and also the toxic substances are not distributed evenly within the host.

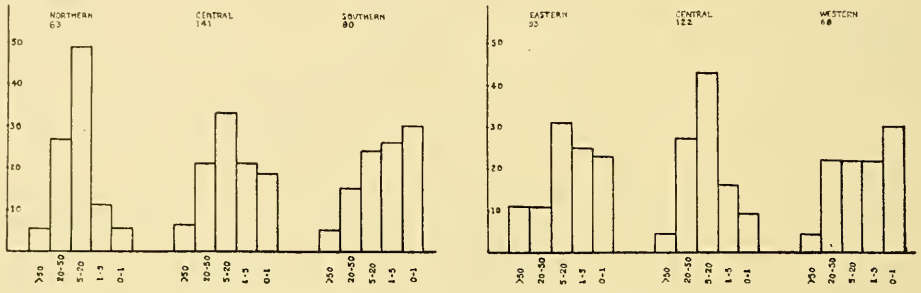


Fig. 19.—Histograms comparing the occurrence of Mistletoe (all species) in various parts of New South Wales. *Left*: Three histograms showing infection in the northern, central and southern areas respectively. *Right*: Three histograms showing infection in the eastern, central and western areas respectively. The 'x' axis indicates the number infected per hundred trees. The 'y' axis indicates the percentage of answers received, for each of the five arbitrary degrees of infection. The number of answers from which each histogram is computed is shown above the figure.

The effects of fire and of opossums on the control of Mistletoe have been discussed earlier.

Measures of controlling Mistletoe usually consist mainly of felling or lopping infected trees. Lopping is carried out in New South Wales as mentioned above in places where Mistletoe is used as drought fodder. Lopping is advised as the chief method of control; where the main trunk is infected, the whole tree may need to be cut down to prevent the Mistletoe from acting as a source of infection to other plants. Bray (1910), in America, suggests lopping the Mistletoe flush with the bark and poison-brushing the wound with, for example, wood creosote or carbolineum. If the parasite has "rooted" in several places each should be treated. There should be more than one pruning, the second to take place some two to three years after the first. If birds are a serious cause of infection, the lopping must be continued regularly. Since ripe fruit and buds of Mistletoe (e.g., *Loranthus Miquelii*) may be found on the same spray, and since the date of maturing of the fruit on the one species may vary with local conditions, no general optimum date for lopping can be stated. Obviously it is better to lop before fruits ripen, and better still before the flowers mature. Further experiments are necessary to refine the measures of control.

Summary.

1. The economic effect of Mistletoe is considered. It appears that the presence of Mistletoe leads to a reduction in the rate of growth, and often the death, of the host tree.

2. It has been shown that Mistletoe in New South Wales is most prevalent and does most damage in the north-east. The Riverina district is least infected.

3. Factors affecting the local distribution of Mistletoe are discussed, and maps have been prepared showing the distribution in New South Wales of the various species of Mistletoes.

4. The distribution of *P. Bidwillii* and the districts of infection by Mistletoe of *Callitris* (western species) are almost, if not quite, coincident. This case appears to

be unique. Most trees of New South Wales appear to be potential hosts to Mistletoe in some district, even if apparently immune in one particular locality. However, Kurrajong is reported free from Mistletoe in many districts, although heavily infected in others.

5. Methods suggested for control of Mistletoe are considered. The lopping or felling of infected trees is the only known control.

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EXPLANATION OF PLATE VI.

A map showing the relative abundance of all species of Mistletoe in New South Wales. Circles indicate places from which estimates of the number infected per hundred host trees have been received. The diameter of the dot is one of five sizes, the largest indicating infection of over 50%, the next infection of 20-50%, the next infection of 5-20%, the next infection of 1-5%, and the smallest infection of 0-1%.

* Original paper not seen by writer.